The African Organisation for Standardisation

EDICT OF GOVERNMENT

ARS 462 (2012) (English): Sorghum grains - Specification

BLANK PAGE

AFRICAN STANDARD

CD-ARS 462

Second Edition 2012

Sorghum grains — Specification

Reference No. ARS 462:2012(E)
ICS 67.060

Table of contents

Foreword

The African Organization for Standardization (ARS) is an African intergovernmental organization made up of the United Nations Economic Commission for Africa (UNECA) and the Organization of African Unity (AU). One of the fundamental mandates of ARSO is to develop and harmonize African Standards (ARS) for the purpose of enhancing Africa's internal trading capacity, increase Africa's product and service competitiveness globally and uplift the welfare of African communities. The work of preparing African Standards is normally carried out through ARSO technical committees. Each Member State interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, regional economic communities (RECs), governmental and non-governmental organizations, in liaison with ARSO, also take part in the work.

ARSO Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare ARSO Standards. Draft ARSO Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an ARSO Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ARSO shall not be held responsible for identifying any or all such patent rights.

ARSO Central Secretariat
International House 3rd Floor
P. O. Box 57363 — 00200 City Square
NAIROBI, KENYA

Tel. +254-20-224561, +254-20-311641, +254-20-311608
Fax: +254-20-218792
E-mail: arso@arso-oran.org
Web: www.arso-oran.org

ARSO Central Secretariat
International House 3rd Floor
P.O. Box 57363 — 00200 City Square
NAIROBI, KENYA

Tel: +254-20-224561, +254-20-311641, +254-20-311608
Fax: +254-20-218792

E-mail: arso@arso-oran.org
Web: www.arso-oran.org

Introduction

Sorghum is the fifth most important cereal crop worldwide. It is drought and heat tolerant and thus an important crop in arid regions where major cereals do not produce sufficient yields. Consumption of sorghum, however, has decreased considerably in many African countries, especially in urban areas.

However, there is renewed interest in many African and foreign countries in the crop due to the wide range of applications and substitutions. Some types are boiled like rice, some cracked like oats for porridge, some "malted" like barley for beer, some baked like wheat into flatbreads, and some popped like popcorn for snacks. A few types have sugary grains and are boiled in the green stage like sweet corn. The whole plant is often used as forage, hay, or silage. The stems of some types are used for building, fencing, weaving, broom-making, and firewood. The stems of other types yield sugar, syrup, and even liquid fuels for powering vehicles or cooking meals. The living plants are used for windbreaks, for cover crops, and for staking yams and other heavy climbers. The seeds are fed to poultry, cattle, and swine. On top of all that, sorghum promises to be a "living factory." Industrial alcohol, vegetable oil, adhesives, waxes, dyes, sizing for paper and cloth, and starches for lubricating oil-well drills are just some of the products that could be obtained.

This African Standard is a technical revision of the earlier ARS 462:1987(E), *Standard for sorghum grains* which is hereby superseded and cancelled.

Sorghum grains — Specification

1 Scope

This African Standard specifies the quality and grading requirements and methods of sampling and test for sorghum grains of varieties (cultivars) grown from *Sorghum bicolor* (L.) Moench intended for human consumption, i.e., ready for its intended use as human food, presented in packaged form or sold loose from the package directly to the consumer. It does not apply to other products derived from sorghum grains.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ARS 53, *General principles of food hygiene — Code of practice*

ARS 56, *Prepackaged foods — Labelling*

CODEX STAN 193, *Codex general standard for contaminants and toxins in food and feed*

ISO 605*, Pulses — Determination of impurities, size, foreign odours, insects, and species and variety — Test methods*

ISO 711, *Cereals and cereal products — Determination of moisture content (Basic reference method)*

ISO 712*, Cereals and cereal products — Determination of moisture content — Routine reference method*

ISO 5223, *Test sieves for cereals*

ISO 6639-1, *Cereals and pulses — Determination of hidden insect infestation — Part 1: General principles*

ISO 6639-2, *Cereals and pulses — Determination of hidden insect infestation — Part 2: Sampling*

ISO 6639-3, *Cereals and pulses — Determination of hidden insect infestation — Part 3: Reference method*

ISO 6639-4, *Cereals and pulses — Determination of hidden insect infestation — Part 4: Rapid methods*

ISO 6888-1, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of coagulase-positive staphylococci (Staphylococcus aureus and other species) — Part 1: Technique using Baird-Parker agar medium*

ISO 6888-2, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of coagulase-positive staphylococci (Staphylococcus aureus and other species) — Part 2: Technique using rabbit plasma fibrinogen agar medium*

ISO 6888-3, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of coagulase-positive staphylococci (Staphylococcus aureus and other species) — Part 3: Detection and MPN technique for low numbers*

ISO 9648, *Sorghum — Determination of tannin*

ISO 13690, *Cereals, pulses and milled products — Sampling of static batches*

ISO 16050, *Foodstuffs — Determination of aflatoxin B_1, and the total content of aflatoxin B_1, B_2, G_1 and G_2 in cereals, nuts and derived products — High performance liquid chromatographic method*

ISO 21527-2, *Microbiology of food and animal feeding stuffs — Horizontal method for the enumeration of yeasts and moulds — Part 2: Colony count technique in products with water activity less than or equal to 0.95*

3 Terms and definitions

For the purpose of this African Standard, the following definitions apply.

3.1
sorghum grain
grain that, before the removal of dockage, consists of 50 % or more of whole kernels of sorghum (*Sorghum bicolor* (L.) Moench) excluding non-grain sorghum and not more than 10.0 % of other grains for which standards have been established.

3.2
broken kernels
pieces of sorghum grain which passes through a screen having round holes of 1.8 mm in diameter

3.3
damaged grains
kernels, pieces of sorghum kernels, and other grains that are badly ground damaged, badly weather damaged, diseased, frost-damaged, germ-damaged, heat-damaged, insect-bored, mould-damaged, sprout-damaged, or otherwise materially damaged.

3.4
decorticated grains
grains from which the external casings and whole or parts of the germ have been removed in an appropriate manner, using mechanical treatment

3.5
foreign matter
all organic and inorganic material other than pearl millet, broken kernels, other grains and filth.
Foreign matter includes loose Pearl millet seed coats.

3.6
immature and shrivelled grains
grains that are not properly developed

3.7
poisonous, toxic and/or harmful seeds
any seed which if present in quantities above permissible limit may have damaging or dangerous effect on health, organoleptic properties or technological performance such as Jimson weed — Datura (*D. fastuosa* Linn and *D. stramonium* Linn.) corn cokle (*Agrostemma githago* L., *Machai Lallium remulenum* Linn.) Akra (Vicia species), *Argemone mexicana*, Khesari and other seeds that are commonly recognized as harmful to health

3.8
sprouted
sprouted grains are those with any visible evidence of root system beginning to emerge

3.9
test weight
the density of a measured volume of grain expressed in kilograms per hectolitre

4 Quality requirements

4.1 General quality requirements

4.1.1 Sorghum grains shall meet the following general requirements/limits as determined using the relevant standards listed in Clause 2:

a) shall be the dried mature grains of *Sorghum bicolor* (L.) Moench;

b) shall be, hard, clean, wholesome, uniform in size and shape;

c) shall be free from abnormal flavours, musty, sour or other undesireable odour, obnoxious smell and discolouration;

d) shall be safe and suitable for human consumption;

e) shall be free from micro-organisms and substances originating from micro-organisms, fungi or other poisonous or deleterious substances in amounts that may constitute a hazard to human health.

4.1.2 Sorghum grains shall be in form of well-filled seeds of uniform colour.

4.2 Specific requirements

4.2.1 Grading

Sorghum grains may be classified into three grades on the basis of the tolerable limits established in Table 1 which shall be additional to the general requirements set out in this standard.

Table 1 — Specific requirements for sorghum grains

Characteristic		**Specification**			**Method of test**
		Grade 1	**Grade 2**	**Grade 3**	
Description		Grain sorghum of red, white or yellow varieties only			
Moisture, max (%)		14	14	14	ISO 711/712
Test weight, Min (kg/hl)		71	62	62	ISO 605
Total admixture max (% by wt) (Total of foreign material, screenings and trash)		11.0	30.0	50.0	
Foreign material max (% by wt)		2.0	3.0	4.0	
Foreign matter, decorticated seed (% by wt)		0.5	0.5	0.5	
Screenings, max (% by wt) (All matter passing through a 2.0 mm slotted screen – 40 shakes in the direction of the slots using an agitator)		11.0	25.0	50.0	
Trash, max (% by wt) (Chaff and other sorghum trash retained above a 2.0 mm slotted screen following the screening process)		5.0	15.0	15.0	
Crude protein, % by dry mass basis, *min*		7.0	7.0	7.0	ISO 20483
Ergot affected grains, %m/m		0.05			Annex A
Tannin content, % on dry mass basis, *max.*	Whole grains	0.5	0.5	0.5	ISO 9648
	Decorticated grains	0.3	0.3	0.3	
Defective grains, max (% by count, 300 grain sample	Weather stained	5.0	20.0	20.0	ISO 605
	Field fungi	5.0	10.0	10.0	
	Dry green	5.0	10.0	10.0	
	Immature grain (fully green in colour)	5.0	10.0	10.0	
	Split/broken	7.0	10.0	10.0	
	Total defective	5.0	8.0	10.0	
Small foreign seeds (% by weight)		1.6	1.6	1.6	
Total aflatoxin (AFB_1+AFB_2+AFG_1 +AFG_2)), ppb, max		10			ISO 16050
Aflatoxin B_1 only, ppb, max		5			
Fumonisin, ppm, max		2			

4.2.2 Ungraded sorghum grains

Ungraded sorghum grains shall be sorghum grains which do not fall within the requirements of Grades 1, 2 and 3 of this standard but meet the minimum requirements provided in 4.1 and are not rejected sorghum grains. Ungraded sorghum can be sorted out to Grade 1, 2 or 3 in accordance with the relevant procedures.

4.2.3 Reject grade sorghum grains

This comprises sorghum grains which have objectionable odour, off flavour, living insects or which do not possess the quality characteristics specified in Table 1. They cannot satisfy the conditions of ungraded sorghum grains and shall be graded as reject sorghum grains and shall be regarded as unfit for human consumption.

5 Contaminants

5.1 Toxic metals

Soghurm grains shall comply with those maximum limits for heavy metals established by the Codex Alimentarius Commission for this commodity.

5.2 Pesticide residues

Soghurm grains shall comply with those maximum pesticide residue limits established by the Codex Alimentarius Commission for this commodity

5.3 Mycotoxin limits

Sorghum grains shall comply with those maximum mycotoxin limits established by the Codex Alimentarius Commission for this commodity. In particular, total aflatoxin levels in sorghum grains for human consumption shall not exceed 10 µg/kg (ppb) with B_1 not exceeding 5 µg/kg (ppb) when tested according to ISO 16050.

6 Hygiene

6.1 Sorghum grains shall be produced, prepared and handled in accordance with the provisions of appropriate sections of ARS 53.

6.4 When tested by appropriate standards of sampling and examination listed in Clause 2, the products:

— shall be free from microorganisms in amounts which may represent a hazard to health and shall not exceed the limits stipulated in Table 2;

— shall be free from parasites which may represent a hazard to health; and

— shall not contain any substance originating from microorganisms in amounts which may represent a hazard to health.

Table 2 — Microbiological limits

	Type of micro-organism	**Limits**	**Test method**
i)	Yeasts and moulds, max. per g	10^4	ISO 21527-2
ii)	*S. aureus* per 25 g	Not detectable	ISO 6888
iii)	*E. Coli*, max. per g	Not detectable	ISO 7251
iv)	*Salmonella,* max. per 25 g	Not detectable	ISO 6579

7 Packaging

7.1 Sorghum grains shall be packed in suitable packages which shall be clean, sound, free from insect, fungal infestation and the packing material shall be of food grade quality.

7.2 Sorghum grains shall be packed in containers which will safeguard the hygienic, nutritional, and organoleptic qualities of the products.

7.3 The containers, including packaging material, shall be made of substances which are safe and suitable for their intended use. They shall not impart any toxic substance or undesirable odour or flavour to the product.

7.4 Each package shall contain Sorghum grains of the same type and of the same grade designation.

7.5 If sorghum grains are presented in bags, the bags shall also be free of pests and contaminants.

7.6 Each package shall be securely closed and sealed.

8 Marking or labelling

In addition to the requirements in ARS 56, each package shall be legibly and indelibly marked with the following:

i) product name as “Whole Sorghum grains”

ii) variety;

iii) grade;

iv) name, address and physical location of the producer/ packer/importer;

v) lot/batch/code number;

vi) net weight, in kg;

vii) the declaration “Food for Human Consumption’’;

viii) storage instruction as “Store in a cool dry place away from any contaminants’’;

ix) crop year;

x) packing date;

xi) instructions on disposal of used package;

xii) country of origin;

xiii) a declaration on whether the sorghum was genetically modified or not.

9 Sampling

Sampling shall be done in accordance with the ISO 13690.

Annex A
(normative)

Determination of ergot

A.1 Test for presence of ergot in food grains

A.1.1 Reagents

(a) **Petroleum ether** — 40 – 60 °C

(b) **Solvent ether**

(c) **Dilute Ammonia** 10 % (v/ v)

(d) **Tartaric acid solution** — 1 % (freshly prepared)

(e) **p-dimethyl amino benzaldehyde (PDAB)** — Dissolve 0.125 gm of PDAB in a cold mixture of 65 ml of conc sulphuric acid and 35 ml of distilled water.

Add 0.1 ml of 5 % Ferric chloride solution and let it stand for 24 hours before use.

A.1.2 Apparatus

(a) Grinding mill

(b) Electric shaker

A.1.3 Procedure

Grind about 50 gm of sample in the grinding mill to a fine powder. Take 10 gm of powdered sample in a stoppered conical flask. Add sufficient petroleum ether and shake for half an hour in the electric shaker. Allow to settle and decant off the petroleum ether. Dry the material in air. Add to the material 8 ml of dilute ammonia and sufficient quantity of solvent ether. Again shake for ½ hour. Filter ether portion in a beaker and concentrate to a small volume. Add 2 ml of tartaric acid solution to the beaker and shake thoroughly. Mix 1 ml of this tartaric acid – sample solution with 1 or 2 ml of p-dimethyl benzaldehyde solution.

The appearance of blue colour indicates presence of ergot.

A.2 Determination of quantity of ergot (*Claviceps purpurea* Tul.)

A.2.1 Objective and field of application

The method is used for both qualitative and quantitative determination of ergot in food and feed. The method is suitable for the examination of food and feed of different particle sizes. In pelleted feedingstuff only qualitative determination is possible.

A.2.2 Principle

Ergot in food and feed is determined by the macroscopic and microscopic identification of the ergot sclerotia and fragments. Quantification is done by weighing the amount of identified sclerotia and fragments with a particle size >0.5 mm.

A.2.3 Reagents

A.2.3.1 Chloral hydrate, β = 60%

A.2.3.2 Sodium hydroxide (pelleted)

A.2.3.3 Potassium hydroxide (pelleted)

A.2.3.4 Ethanol, σ = 50%

A.2.3.5 Acetone

The reagents listed can be replaced by others which produce comparable results.

A.2.4 Equipment and accessories

A.2.4.1 Optical equipment

A.2.4.1.1 Stereo microscope (up to 70x magnification)

A.2.4.1.2 Magnifier (up to 10x magnification)

A.2.4.2 Mortar and pestle

A.2.4.3 Sieves fitted with wire nettings or perforations with different mesh sizes (e.g. 2.0 mm, 1.0 mm, 0.5 mm, 0.25 mm) and collecting tray; recommended additional equipment: sieve towers, sieve shaker

A.2.4.4 Analytical balance (accuracy 0.001 g)

A.2.4.5 Oven (up to 130 °C)

A.2.4.6 Laboratory glassware

A.2.4.7 Filters (e.g. paper, gaze)

A.2.4.8 Freeze dryer

A.2.4.9 Hot plate or Bunsen burner

A.2.4.10 Reference material

A.2.5 Procedure

The examination is performed in non-pelleted food and feed. Pelleted food and feed have to be depelleted before examination (A.2.4.2; A.2.8.1).

Qualitative determination of the sclerotia is performed macroscopically and microscopically considering ergot and its fragments in both the sieve fraction >0.5mm and < 0.5mm.

Quantification is performed by selecting and weighing of ergot and its fragments with a particle size >0.5mm out of the laboratory sample or an aliquot of it.

A.2.5.1 Preparation of the laboratory sample

A.2.5.1.1 Whole kernel feedingstuff (at least 250g) are weighed (A.2.4.4) and used directly for the investigation (A.2.5.2 and A.2.5.3).

A.2.5.1.2 Non-pelleted feedingstuff (at least 10g) are weighed (A.2.4.4) and fractionated bysieving. The obtained fractions > 0.5mm and $\leq$ 0.5mm are weighed (A.2.4.4).

A.2.5.2 Identification of ergot

Ergot sclerotia are identified based on their characteristic features. The identification may be facilitated by comparison to reference material (A.2.4.10) and existing descriptions.

Morphology: *Ergot sclerotia* Tul. are elongated with a length up to several centimetres, coloured dark violet to black. The shape is similar to cereal kernels. They only consist of fungal hyphae.

Anatomy: Cross sections through the random parts of ergot sclerotia show very small, narrow interconnected hyphae which yield a dense pseudoparenchymatic tissue. The cells contain lots of fat oil. The outer layers of the hyphae are coloured dark violet to black, whereas the inner parts are coloured light pink to violet.

For the identification of ergot fragments in the sieve fractions <0.5mm the following colour reaction can be used. This staining procedure is only applicable to fresh sclerotia material.

A filter paper is soaked with a solution of 3ml ethanol (A.2.3.4) and 2 sodium hydroxide pellets (A.2.3.2) or 2 potassium hydroxide pellets (A.2.3.3). The sample is distributed on the filter paper.

After app. 5 min. a red-violet halo around the ergot fragments is observed.

The dark violet colouring of the outer hyphae layers is dissolved also in chloralhydrate (A.2.3.1) and colours it violet.

A.2.5.3 Quantification

The quantification of ergot is performed using the sieve fractions > 0.5 mm.

Material identified as ergot in each fraction is selected and weighed. An aliquot of the sieved fractions may be used if necessary. The ergot content of the fractions >0.5mm is summarized and expressed in mg/kg feedingstuff (A.2.6.1).

A.2.6 Calculation and report

A.2.6.1 Calculation

The amount of ergot fragments in mg/kg (ppm) feedingstuff (original sample) is calculated using the following formula:

$$C = \frac{BC \times 1000}{E} \text{ [mg/kg]}$$

C = amount of component in mg/kg feedingstuff (ppm)

BC = selected fragments of component in the laboratory sample or an aliquot of it [mg]

E = total weight of the laboratory sample or an examined aliquot of the laboratory sample [g]

A.2.6.2 Report

A.2.6.2.1 Negative result:

As far as was discernible using a microscope, ergot was not found in the submitted sample.

A.2.6.2.2 Positive result:

As far as was discernible using a microscope xx mg ergot/kg feedingstuff were found in the submitted sample. For quantification ergot particles >0.5 mm are considered.

A.2.6.2.3 Possible adding to the report:

In pelleted feedingstuff only qualitative determination of ergot is possible.

A.2.8 Remarks

A.2.8.1 For the identification of ergot in pelleted feedingstuffs, the sample is depleted using either of the following procedures:

(a) At least 10 g of the pressed material is mixed with at least three times as much water. The suspension is stirred up several times and left standing until the pellets disintegrate. Then the depelletised material is filtered (A.2.4.7) and dried at room temperature or freeze-dried (A.2.4.8).

(b) For depelletising at high humidity pressed material (at least 10 g) is left standing in humid atmosphere at 70 °C (A.2.4.5) until the pellets disintegrate. The material is crushed, sieved (A.2.4.3) and dried at room temperature immediately to prevent the particles from sticking together again.

A.2.8.2 Ergot are the permanent forms or sclerotia of ergot which mainly occur in rye, more seldom in wheat, triticale and barley.

A.2.8.3 This method also is suitable for the examination of raw material and food.

Bibliography

EAS 757:2011, *Sorghum grains — Specification*

CODEX STAN 172:1989 (Rev.1:1995), *Standard for Sorghum Grains*

United Stated Standards for Sorghum, Effective June 2008

Malawi Standard, MBS 612:1997, *Sorghum — Determination of tannin content*

Ethiopian Standard, ES 674:2001, *Sorghum — Specification*

Department of Agriculture — South African Government Notice No. R. 532 of 16th May 2008, *Regulations relating the Grading, packing and marking of sorghum intended for sale in the Republic of South Africa*

ISO 9648:1988, *Sorghum — Determination of tannin content published by the International Organization for Standardization (ISO)*

CODEX STAN 228:2001 (Rev.1:2004), *General methods of analysis for contaminants*

